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(54) **HIGH FREQUENCY MODULE AND RADIO DEVICE USING THE SAME**

HOCHFREQUENZMODUL UND FUNKEINRICHTUNG DAMIT

MODULE HAUTE FREQUENCE ET DISPOSITIF RADIO UTILISANT UN TEL MODULE

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Description

TECHNICAL FIELD

[0001] The present invention relates to a high-frequency module employed for mobile communications and a wireless device using the high-frequency module.

BACKGROUND ART

[0002] In a high-frequency circuit, a spurious signal generated in a mixing circuit and a matching circuit is removed by a filter circuit. Such a high-frequency circuit has conventionally been configured as a single module. Fig. 6 shows a conventional high-frequency module. In the conventional high-frequency circuit block, mixing circuit 12 mixes a baseband signal fed from baseband section 31 with a local signal fed from oscillator 41. A spurious signal produced by mixing circuit 12 is attenuated by first filter 13 and second filter 22 of filter circuit 18. A desired high-frequency signal has thus been obtained.

[0003] In the prior-art high-frequency module, however, due to the structure configured in one module, a spurious signal produced by matching device 14 connected to the input side of first filter 13 directly goes, without passing through first filter 13, matching device 17, and second filter 22, into matching device 24. In the module, matching device 17 is connected to the output side of first filter 13 and the input side of second filter 22, and matching device 24 is located to the output side of second filter 22.

[0004] Therefore, in matching device 24, the spurious signal directly come from matching device 14 has an output level greater than that of the spurious signal given attenuation by first filter 13 and second filter 22, accordingly, the resultant spurious signal cannot maintain a desirable attenuation level. As a result, the output level of the spurious signal fed from the high-frequency module has undesirably increased.

DISCLOSURE OF THE INVENTION

[0005] The present invention addresses the problem above. It is therefore the object to provide a high-frequency module capable of offering a spurious signal with a preferably suppressed output level.

[0006] To achieve the object, the structure of the present invention has the high-frequency circuit formed of two sections: the first high-frequency circuit having a first filter circuit, and the second high-frequency circuit having a second filter circuit.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007]

Fig. 1 is a perspective view of a high-frequency module of an exemplary embodiment of the present in-

vention.

Fig. 2 is an enlarged side view of the high-frequency module of the exemplary embodiment.

Fig. 3 is a top view of the high-frequency module of the exemplary embodiment.

Fig. 4 is a circuit diagram of the high-frequency module of the exemplary embodiment.

Fig. 5 is a general block diagram of a wireless device employing the high-frequency module of the present invention.

Fig. 6 is a block diagram of a conventional high-frequency module.

DETAILED DESCRIPTION OF CARRYING OUT OF THE INVENTION

[0008] An exemplary embodiment of the present invention is described hereinafter with reference to the accompanying drawings, Fig.1 through Fig. 4.

[0009] Fig. 1 is a perspective view of high-frequency module 100 of an exemplary embodiment of the present invention. High-frequency module 100 of the present invention contains first high-frequency circuit 5 and second high-frequency circuit 6.

[0010] In first high-frequency circuit 5 of the present invention, mixing circuit 12 and first filter circuit 16 are mounted on first circuit board 201, and over which, metallic case 4 is fixed to cover them.

[0011] Fig. 2 shows an enlarged side view of high-frequency module 100. Edge electrode 7 is formed at the side of first circuit board 201. In the structure, high-frequency noise is shielded by electrically connecting between the GND electrode of edge electrode 7 and terminal 3 formed on metallic case 4 with solder 8.

[0012] On the other hand, in second high-frequency circuit 6 shown in Fig. 1, the second filter circuit is mounted on second circuit board 202. Like first high-frequency circuit 5, metallic case 4 covers components of the filter circuit.

[0013] As shown in Fig. 3, which is a top view of the structure of high-frequency module 100, first high-frequency circuit 5 and second high-frequency circuit 6 are mounted on motherboard 1. The high-frequency circuit of the present invention is configured by establishing a high-frequency connection between the two circuits through signal line 10 on motherboard 1.

[0014] The connecting line has an impedance of 50 ohm. GND pattern 9 is formed around the signal line to protect the signal line from an effect of noise, whereby the characteristics of the high-frequency module is maintained.

[0015] Now will be described how the high-frequency circuit of the present invention works, with reference to Fig. 4.

[0016] Base band section 31 outputs a 380 MHz base band signal; on the other hand, oscillator 41 outputs a 1760 MHz local signal. The two signals are added at mixer 12 to be resultant output of 2140 MHz. The resultant

signal passes through matching device 14 of first filter circuit 16 and enters into first filter 13. First filter 13 is a dielectric filter, which can substantially eliminate noise of a local signal, thereby attenuating the 1760 MHz spurious signal fed from mixer 12 by 50 dB to feed the signal to matching device 15. In the structure, matching device 14 is located to the input side of first filter 13; on the other hand, matching device 15 is located to the output side of first filter 13. Such an arrangement decreases radiation caused by unmatched impedance. As a result, the spurious signal, which is fed from the input side of matching device 14 and, without passing through first filter 13, fed into matching device 15, is attenuated more than 60 dB. That is, first filter circuit 16 can constantly keep 50 dB attenuation.

[0017] Besides, as described above, covering first high-frequency circuit 11 with metallic case 4 can suppress the spurious signal fed from the circuit.

[0018] Next, the output signal from matching device 15 goes into matching device 23, which forms second filter circuit 19 of second high-frequency circuit 21. Given impedance matching by matching device 23, the output signal is fed into second filter 22. Second filter 22 is a dielectric filter, which can substantially eliminate noise of a spurious signal, thereby attenuating the 1760 MHz spurious signal fed from mixer 12 by 50 dB to feed the signal to matching device 24. In second high-frequency circuit 21, matching device 23 is located to the input side of second filter 22; on the other hand, matching device 24 is located to the output side of second filter 22. Such an arrangement decreases radiation caused by unmatched impedance. As a result, the spurious signal from the local signal, which is fed from matching device 23 and, without passing through second filter 22, fed into matching device 24, is attenuated more than 60 dB. On the other hand, the spurious signal generated by the local signal fed into matching device 24 directly from matching device 14 of first high-frequency circuit 11, without traveling through first filter 13, matching devices 15 and 23, and second filter 22, is attenuated more than 110 dB. As a result, second filter circuit 19 can constantly keep 50 dB attenuation.

[0019] With the structure of first high-frequency circuit 11 and second high-frequency circuit 21, a desired amount of attenuation, i.e., 100 dB attenuation of the spurious signal can be achieved.

[0020] Although the explanation above introduces the structure in which high-frequency module 100 employs a matching device, it is not limited thereto; an amplifier and an isolator can be used with the matching device to obtain the similar effect.

[0021] Although the explanation above introduces a structure employing a single mixer, it is not limited thereto; a structure having two or more mixers can provide the similar effect.

[0022] Although the explanation above introduces a structure employing dielectric filters for filter 13 and filter 22, it is not limited thereto; a high-frequency module em-

ploying filters with an excellent quality in eliminating noise, such as a surface acoustic wave (SAW) filter and a MEMS filter, can provide the similar effect.

[0023] Although the explanation above introduces a structure employing two filters, it is not limited thereto; a high-frequency module having three or more filters can provide the similar effect.

[0024] Although the explanation above introduces a structure employing two high-frequency circuits, it is not limited thereto; a structure having three or more circuits can provide the similar effect.

[0025] Although the explanation above introduces a structure in which a base band signal fed from base band section 31 has a frequency of 380 MHz, and a local signal has a frequency of 1760 MHz, it is not limited thereto; a structure in which a local signal has a frequency ranging from 1730 to 1790 MHz can provide the similar effect.

[0026] Although the explanation above introduces a structure in which a base band signal fed from base band section 31 has a frequency of 380 MHz, and a local signal has a frequency of 1760 MHz, it is not limited thereto; a structure in which a base band signal has a frequency ranging from 10 to 400 MHz can provide the similar effect.

[0027] In the embodiment high-frequency circuit is covered with metallic case in order to suppress the spurious signal fed from the circuit. Instead of the metallic case, a conductive case formed of (a) an insulating resin for covering the circuits and (b) metal plating for covering a surface of the insulating resin can be also used.

[0028] Fig. 5 shows wireless device 61 employing high-frequency module 100 of the present invention. In the structure, a base band signal fed from base band section 31 and a local signal fed from oscillator 41 are fed into first high-frequency circuit 11 to have frequency conversion. The signal from circuit 11 passes through second high-frequency circuit 21 and front-end section 62 and goes out from antenna 63 into the air. The wireless device employing high-frequency module 100 of the present invention is highly effective in attenuating a spurious signal, accordingly, the spurious signal radiated from antenna 63 is preferably suppressed. The wireless device capable of suppressing a spurious signal to a low level can thus be obtained.

INDUSTRIAL APPLICABILITY

[0029] According to the structure of the present invention, as described above, the high-frequency circuit is divided into two sections: a first high-frequency circuit having a first filter circuit, and a second high-frequency circuit having a second filter circuit. With the structure, a high frequency module capable of suppressing the output of a spurious signal can be obtained.

Claims

1. A high-frequency module (100) comprising:

a) a first high-frequency circuit (11) including:

a-1) a mixing circuit (12) for mixing a base band signal fed from a base band section (31) with a local signal fed from an oscillator (41); and

a-2) a first filter circuit (16) for attenuating a local leak from the mixing circuit (12); and

b) a second high-frequency circuit (21) containing a second filter circuit (19) for attenuating a local leak from the first filter circuit (16),

wherein at least any one of the first high-frequency circuit (11) and the second high-frequency circuit (21) is covered with a separate conductive case (4).

2. The high-frequency module of Claim 1, wherein the conductive case is made of metal.

3. The high-frequency module of Claim 1, wherein the conductive case is formed of i) an insulating resin for covering the circuits, and ii) metal plating for covering a surface of the insulating resin.

4. The high-frequency module of Claim 1, wherein the first filter circuit and the second filter circuit include a dielectric filter.

5. The high-frequency module of Claim 1, wherein a signal line with an impedance of 50Ω connects between the first high-frequency circuit and the second high-frequency circuit.

6. The high-frequency module of Claim 1 further includes a motherboard, on which a first circuit board containing the first high-frequency circuit, a second circuit board containing the second high-frequency circuit, and the 50Ω-signal line connecting between the first high-frequency circuit and the second high-frequency circuit are mounted.

7. A wireless device employing a high-frequency module (100), the high-frequency module (100) comprising:

a) a first high-frequency circuit (11) further including:

a-1) a mixing circuit (12) for mixing a base band signal fed from a base band section (31) with a local signal fed from an oscillator (41); and

a-2) a first filter circuit (16) for attenuating a local leak from the mixing circuit (12); and

b) a second high-frequency circuit (21) containing a second filter circuit (19) for attenuating a

local leak from the first filter circuit (16), wherein at least any one of the first high-frequency circuit (11) and the second high-frequency circuit (21) is covered with a separate conductive case (4).

8. The wireless device of Claim 7, wherein the high-frequency module includes a motherboard, on which a first circuit board containing the first high-frequency circuit, a second circuit board containing the second high-frequency circuit, and the 50Ω-signal line connecting between the first high-frequency circuit and the second high-frequency circuit are mounted.

15 Patentansprüche

1. Hochfrequenzmodul (100) mit:

a) einer ersten Hochfrequenzschaltung (11), die Folgendes aufweist:

a-1) eine Mischschaltung (12) zum Mischen eines von einem Basisbandteil (31) eingespeisten Basisbandsignals mit einem von einem Oszillator (41) eingespeisten lokalen Signal und

a-2) eine erste Filterschaltung (16) zum Abschwächen eines lokalen Verluststroms von der Mischschaltung (12); und

b) einer zweiten Hochfrequenzschaltung (21) mit einer zweiten Filterschaltung (19) zum Abschwächen eines lokalen Verluststroms von der ersten Filterschaltung (16),

wobei die erste Hochfrequenzschaltung (11) und/oder die zweite Hochfrequenzschaltung (21) mit einem gesonderten leitfähigen Gehäuse (4) ummantelt ist.

2. Hochfrequenzmodul nach Anspruch 1, **dadurch gekennzeichnet, dass** das leitfähige Gehäuse aus Metall besteht.

3. Hochfrequenzmodul nach Anspruch 1, **dadurch gekennzeichnet, dass** das leitfähige Gehäuse aus I) einem Isolierharz zum Ummanteln der Schaltungen und II) einem galvanischen Metallüberzug zum Bedecken einer Oberfläche des Isolierharzes besteht.

4. Hochfrequenzmodul nach Anspruch 1, **dadurch gekennzeichnet, dass** die erste Filterschaltung und die zweite Filterschaltung ein dielektrisches Filter aufweisen.

5. Hochfrequenzmodul nach Anspruch 1, **dadurch gekennzeichnet, dass** eine Signalleitung mit einer Impedanz von 50 Ω die erste Hochfrequenzschaltung

mit der zweiten Hochfrequenzschaltung verbindet.

6. Hochfrequenzmodul nach Anspruch 1, das weiterhin ein Motherboard aufweist, auf dem eine erste Leiterplatte, die die erste Hochfrequenzschaltung enthält, eine zweite Leiterplatte, die die zweite Hochfrequenzschaltung enthält, und die 50-Ω-Signalleitung montiert sind, die die erste Hochfrequenzschaltung mit der zweiten Hochfrequenzschaltung verbindet.

7. Funkgerät, das ein Hochfrequenzmodul (100) verwendet, das Folgendes aufweist:

a) eine erste Hochfrequenzschaltung (11), die weiterhin Folgendes aufweist:

a-1) eine Mischschaltung (12) zum Mischen eines von einem Basisbandteil (31) eingespeisten Basisbandsignals mit einem von einem Oszillator (41) eingespeisten lokalen Signal und

a-2) eine erste Filterschaltung (16) zum Abschwächen eines lokalen Verluststroms von der Mischschaltung (12); und

b) eine zweite Hochfrequenzschaltung (21) mit einer zweiten Filterschaltung (19) zum Abschwächen eines lokalen Verluststroms von der ersten Filterschaltung (16),

wobei die erste Hochfrequenzschaltung (11) und/oder die zweite Hochfrequenzschaltung (21) mit einem gesonderten leitfähigen Gehäuse (4) ummantelt ist.

8. Funkgerät nach Anspruch 7, **dadurch gekennzeichnet, dass** das Hochfrequenzmodul ein Motherboard aufweist, auf dem eine erste Leiterplatte, die die erste Hochfrequenzschaltung enthält, eine zweite Leiterplatte, die die zweite Hochfrequenzschaltung enthält, und die 50-Ω-Signalleitung montiert sind, die die erste Hochfrequenzschaltung mit der zweiten Hochfrequenzschaltung verbindet.

Revendications

1. Module haute fréquence (100) comprenant :

a) un premier circuit haute fréquence (11) incluant :

a-1) un circuit de mélange (12) pour mélanger un signal de bande de base alimenté à partir d'une section de bande de base (31) avec un signal local alimenté à partir d'un oscillateur (41) ; et

a-2) un premier circuit de filtre (16) pour at-

ténuer une fuite locale du circuit de mélange (12) ; et

b) un deuxième circuit haute fréquence (21) contenant un deuxième circuit de filtre (19) pour atténuer une fuite locale du premier circuit de filtre (16),

dans lequel au moins l'un quelconque du premier circuit haute fréquence (11) et du deuxième circuit haute fréquence (21) est recouvert avec un boîtier conducteur (4) séparé.

2. Module haute fréquence selon la revendication 1, dans lequel le boîtier conducteur est constitué de métal.

3. Module haute fréquence selon la revendication 1, dans lequel le boîtier conducteur est formé i) d'une résine d'isolation pour recouvrir les circuits, et ii) d'un placage métallique pour recouvrir une surface de la résine d'isolation.

4. Module haute fréquence selon la revendication 1, dans lequel le premier circuit de filtre et le deuxième circuit de filtre incluent un filtre diélectrique.

5. Module haute fréquence selon la revendication 1, dans lequel une ligne de signaux avec une impédance de 50 Ω fait la connexion entre le premier circuit haute fréquence et le deuxième circuit haute fréquence.

6. Module haute fréquence selon la revendication 1, incluant en outre une carte mère, sur laquelle une première carte de circuit contenant le premier circuit haute fréquence, une deuxième carte de circuit contenant le deuxième circuit haute fréquence, et la ligne de signaux 50 Ω faisant la connexion entre le premier circuit haute fréquence et le deuxième circuit haute fréquence sont montées.

7. Dispositif sans fil employant un module haute fréquence (100), le module haute fréquence (100) comprenant :

a) un premier circuit haute fréquence (11) incluant en outre :

a-1) un circuit de mélange (12) pour mélanger un signal de bande de base alimenté à partir d'une section de bande de base (31) avec un signal local alimenté à partir d'un oscillateur (41) ; et

a-2) un premier circuit de filtre (16) pour atténuer une fuite locale du circuit de mélange (12) ; et

b) un deuxième circuit haute fréquence (21) contenant un deuxième circuit de filtre (19) pour atténuer une fuite locale du premier circuit de filtre (16), dans lequel au moins l'un quelconque du premier circuit haute fréquence (11) et du deuxième circuit haute fréquence (21) est recouvert avec un boîtier conducteur (4) séparé.

8. Dispositif sans fil selon la revendication 7, dans lequel le module haute fréquence inclut une carte mère, sur laquelle une première carte de circuit contenant le premier circuit haute fréquence, une deuxième carte de circuit contenant le deuxième circuit haute fréquence, et la ligne de signaux 50 Ω faisant la connexion entre le premier circuit haute fréquence et le deuxième circuit haute fréquence sont montées.

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FIG. 1

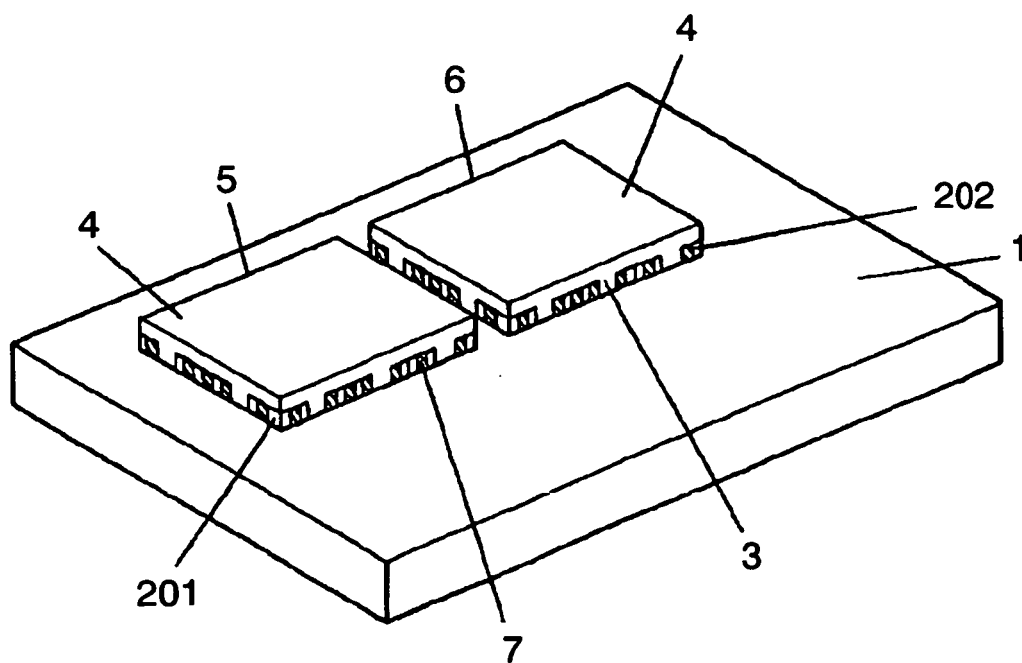


FIG. 2

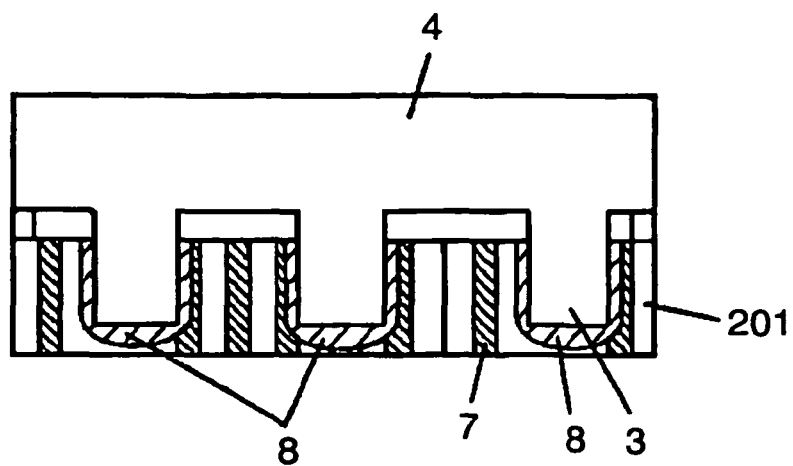


FIG. 3

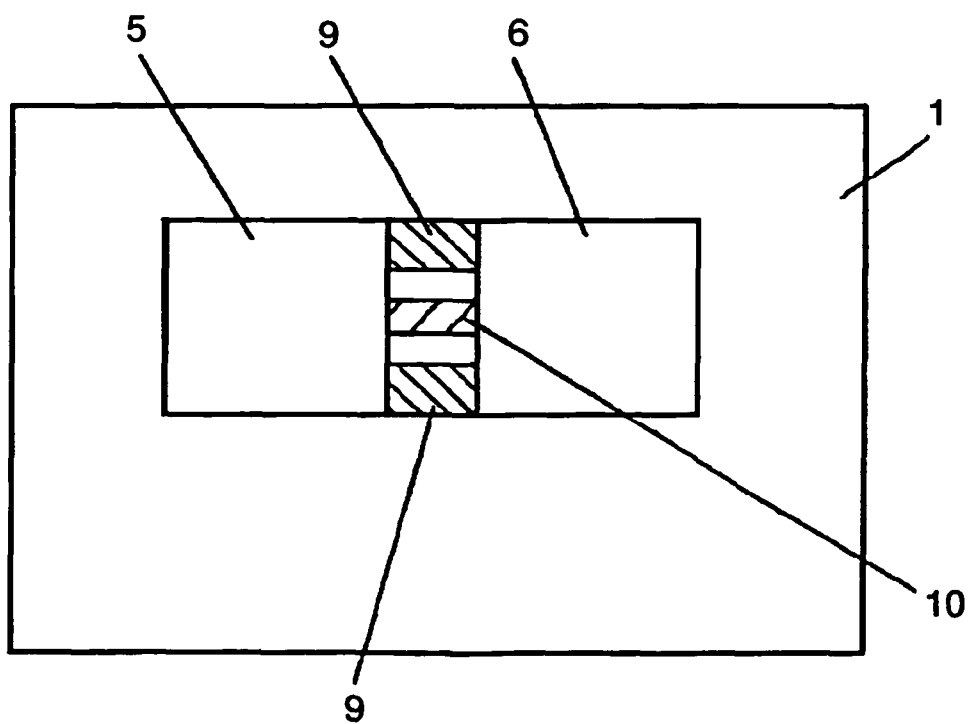


FIG. 4

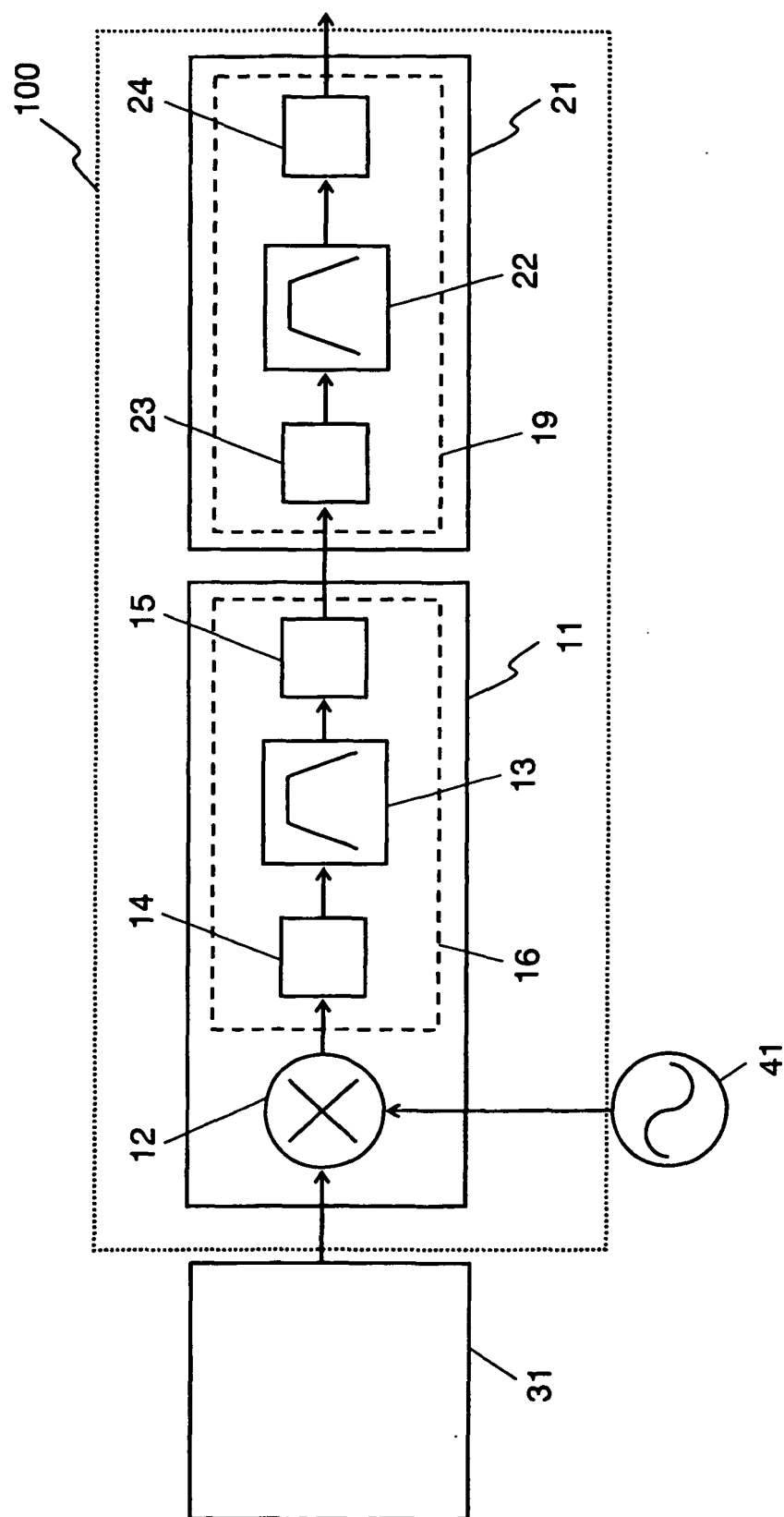


FIG. 5

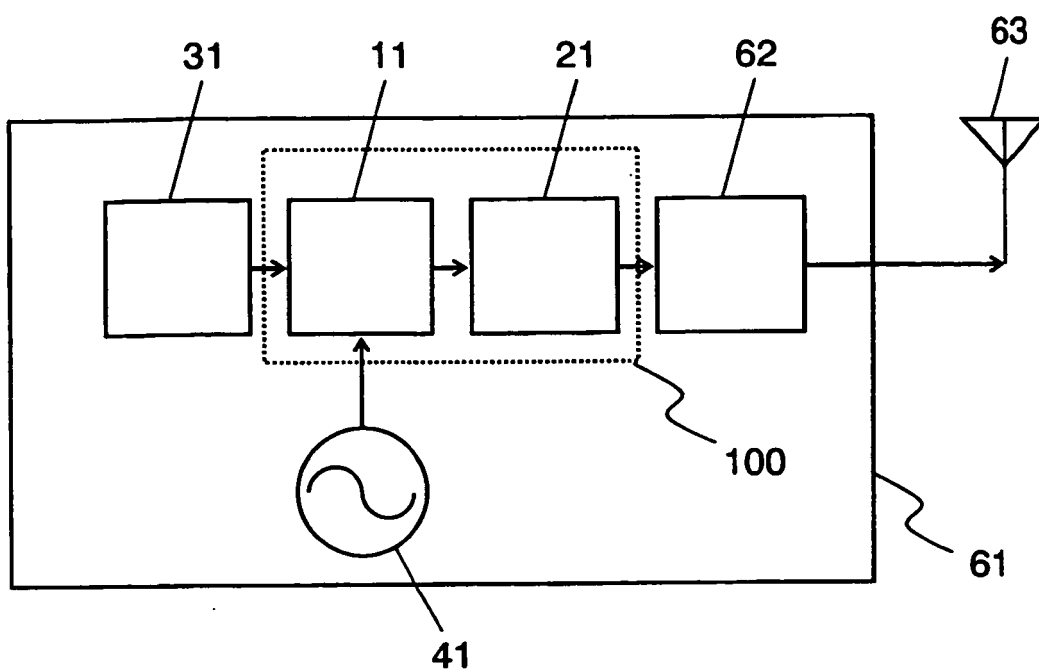
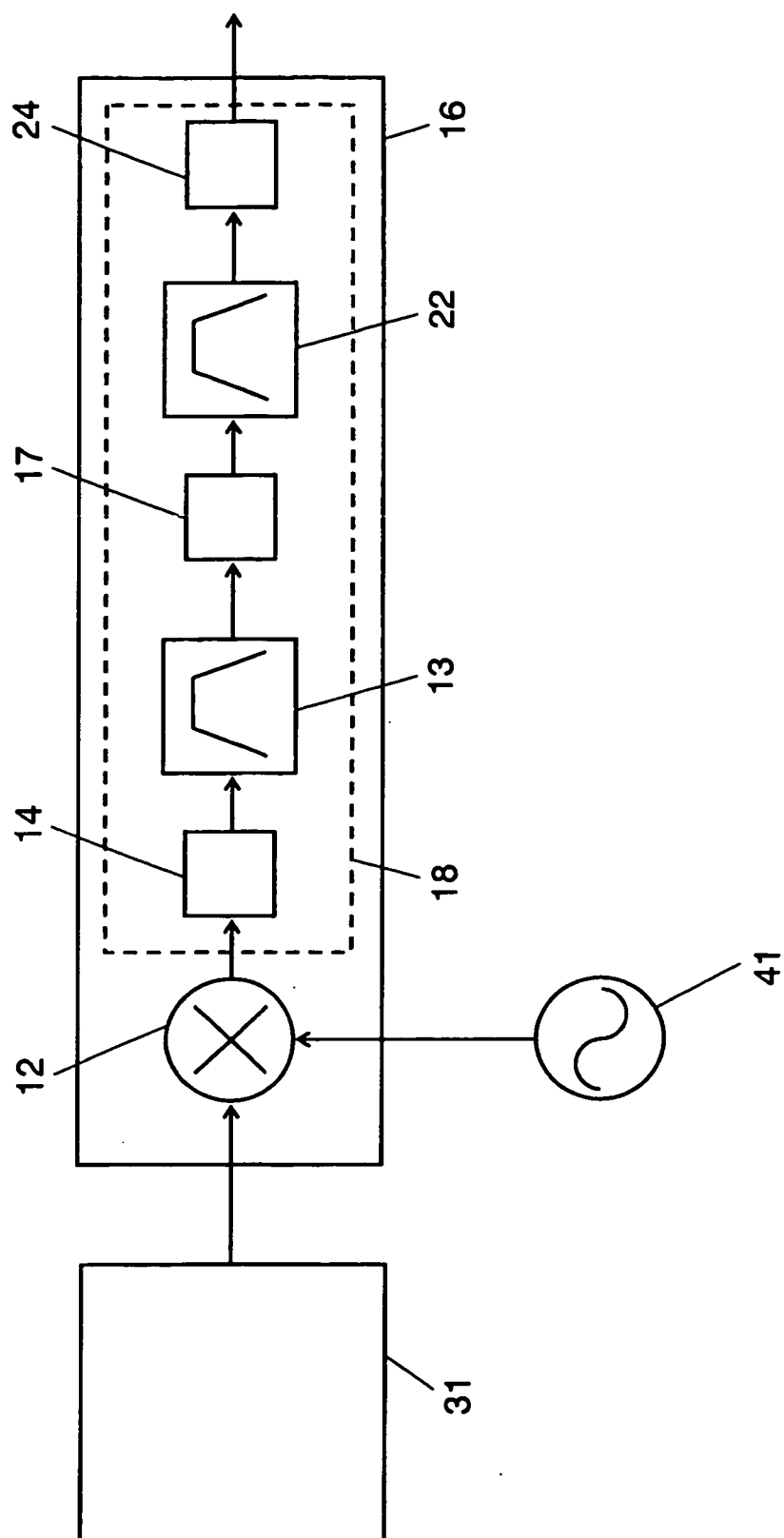


FIG. 6



Reference numbers in the drawings

- 1: motherboard**
- 201: first circuit board**
- 202: second circuit board**
- 3: terminal**
- 4: metallic case**
- 5: first high-frequency circuit**
- 6: second high-frequency circuit**
- 7: edge electrode**
- 8: solder**
- 9: GND pattern**
- 10: signal line**
- 11: first high-frequency circuit**
- 12: mixing circuit**
- 13: first filter**
- 22: second filter**
- 14, 15, 23, 24: matching device**
- 16: first filter circuit**
- 19: second filter circuit**
- 21: second high-frequency circuit**
- 31: base band section**
- 41: oscillator**
- 61: wireless device**
- 62: front end section**
- 64: antenna**
- 100: high-frequency module**